

# Enhanced A+ Guide to Managing and Maintaining Your PC

Comprehensive Enhanced Third Edition

Jean Andrews, Ph.D.



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1.1 Identify basic terms, concepts, and functions of system modules, including how each module should work during normal operation and during the boot process. <i>Examples of concepts and modules:</i>		
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■ Processor/CPU	1, 3	4, 115-116
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■ Storage device	5, 6, 7, 10, 15	263-267, 291-292, 340-347, 522-525, 808-814
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■ PC Card	18	1016-1021
■ Pointing Devices	9	487-489
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■ Upgrading BIOS	1, 3	22, 134-138
■ When to upgrade BIOS	3, 7	137, 350-351
Portable Systems:		
■ Battery	18	1013
■ Hard drive	18	1021
■ Types I, II, III cards	18	1016-1017
■ Memory	18	1014
2.1 Identify common symptoms and problems associated with each module and how to troubleshoot and isolate the problems. <i>Content may include the following:</i>		
■ Processor/Memory symptoms	8, Appendix E	415-418, E2-E6
■ Mouse	9, Appendix E	475-477, E10
■ Floppy drive	5, Appendix E	259-261, E8-E10
■ Parallel ports	9	462-465
■ Hard Drives	7, 8, Appendix E	355-357, 375, 378, 402, 418, E10-E12
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■ NIC	17	927-936, 974-975

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■ Power supply	8, 11, Appendix E	414-415, 569-572, 574-576, E2-E8
■ Slot covers	11	566
■ POST audible/visual error codes	8, Appendix E	415-417, A1-A2
■ Troubleshooting tools, e.g., multimeter	11	566-567, 596
■ Large LBA, LBA	6	302, 306
■ Cables	9, 11	457-459, 464-465, 596
■ Keyboard	8, 9	421-422, 483-487
■ Peripheral	8, 9	421-431, 454-471
2.2 Identify basic troubleshooting procedures and good practices for eliciting problem symptoms from customers. <i>Content may include the following:</i>		
■ Troubleshooting/isolation/problem determination procedures	2, 8, 10, 19	82, 402, 408-421, 540-542, 1048-1049
■ Determine whether hardware or software problem	2, 8	87-91, 411-413
■ Gather information from user regarding, e.g.,		
■ Customer Environment	8, 20	410-411, 1073
■ Symptoms/Error Codes	8, 20	410-411, 1073
■ Situation when the problem occurred	8, 20	410-411, 1073
3.1 Identify the purpose of various types of preventive maintenance products and procedures and when to use them. <i>Content may include the following:</i>		
■ Liquid cleaning compounds	9, 19	488, 1028-1030
■ Types of materials to clean contacts and connections	8, 9	421-422, 488
■ Non-static vacuum (chasis, powersupplies, fans)	19	1028-1030
3.2 Identify issues, procedures and devices for protection within the computing environment, including people, hardware, and the surrounding workspace. <i>Content may include the following:</i>		
■ UPS (Uninterruptible Power Supply) and suppressors	11	581-584

## *A+ Core Hardware Examination*

OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ Determining the signs of power issues	8, 11	414-415, 574-576
■ Proper methods of storage of components for future use	3	165-167
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■ High-voltage equipment	11	574, 588
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■ CRT	19	1031
Special disposal procedures that comply with environmental guidelines		
■ Batteries	19	1031
■ CRTs	19	1031
■ Toner kits/cartridges	19	1032
■ Chemical solvents and cans	19	1032
■ MSDS (Material Safety Data Sheet)	19	1032
ESD (Electrostatic Discharge) precautions and procedures		
■ What ESD can do, how it may be apparent, or hidden	3, 11	165, 565-566
■ Common ESD protection devices	3	165-167
■ Situations that could present a danger or hazard	3	167
4.1 Distinguish between the popular CPU chips in terms of their basic characteristics. <i>Content may include the following:</i>		
■ Popular CPU chips (Intel, AMD, Cyrix)	3	115-116, 118-125
■ Characteristics	3	116-125
■ Physical size	3	127
■ Voltage	3	128
■ Speeds	3	120-121, 123-124
■ On board cache or not	3	119-121
■ Sockets	3	127-130
■ SEC (Single Edge Contact)	3	122-123, 127-130
4.2 Identify the categories of RAM (Random Access Memory) terminology, their locations, and physical characteristics. <i>Content may include the following:</i>		
■ Terminology:		
■ EDO RAM (Extended Data Output RAM)	3, 4	141, 185

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OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ DRAM (Dynamic Random Access Memory)	3, 4	139, 185
■ SRAM (Static RAM)	3, 4	139, 182-184
■ RIMM (Rambus Inline Memory Module 184 Pin)	4	186-187
■ VRAM (Video RAM)	9	499
■ SDRAM (Synchronous Dynamic RAM)	4	185-187
■ WRAM (Windows Accelerator Card RAM)	9	499
■ Locations and physical characteristics:		
■ Memory bank	4	219-222
■ Memory chips (8-bit, 16-bit, and 32-bit)	4	219-222
■ SIMMS (Single In-line Memory Module)	3	140-141
■ DIMMS (Dual In-line Memory Module)	3	140-141
■ Parity chips versus non-parity chips	3	139
4.3 Identify the most popular types of motherboards, their components, and their architecture (bus structures and power supplies). <i>Content may include the following:</i>		
■ Types of motherboards:	3	110-112, 132-134
■ AT (Full and Baby)	3	110-112
■ ATX	3	110-112
■ Components:		
■ Communication ports	3, 9	112-113, 455-456, 459, 462
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■ Basic compatibility guidelines	3, 11	110-114, 131-134, 568-573
■ IDE (ATA, ATAPI, ULTRA-DMA, EIDE)	6, 10	283-284, 523
■ SCSI (Wide, Fast, Ultra, LVD (Low Voltage Differential))	6, 9	286-287, 477-478

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OBJECTIVES	CHAPTERS	PAGE NUMBERS
4.4 Identify the purpose of CMOS (Complementary Metal-Oxide Semiconductor), what it contains, and how to change its basic parameters. <i>Example Basic CMOS Settings:</i>		
■ Printer parallel port		
■ Uni-, bi-directional	3, 9	158-159, 463-464
■ disable/enable	3, 9	158-159, 463-464
■ ECP, EPP	3, 9	158-159, 463-464
■ COM/serial port		
■ memory address	3, 9	158-159, 455-456
■ interrupt request	3, 9	158-159, 455-456
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■ enable/disable drive or boot	3	158-159
■ speed	3, 5	158-159, 240
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■ Hard drive – size and drive type	6, 7	302, 347-350
■ Memory parity		
■ parity	3	159
■ non-parity	4	187
■ Boot sequence	3	159
■ Date/Time	2	97
■ Passwords	2	96-97
■ Plug & Play BIOS	3, 9	136, 470-472
5.1 Identify basic concepts, printer operations, and printer components. <i>Content may include the following:</i>		
■ Paper feed mechanisms	8, 18	429-430, 993-994
■ Types of Printers		
■ Laser	18	988-993
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Types of printer connections and configurations		
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OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ Infrared	9, 18	459, 988
■ Serial	9, 18	455-459, 988
5.2 Identify care and service techniques and common problems with primary printer types. <i>Content may include the following:</i>		
■ Feed and output	8, 18	429-431, 993-994
■ Errors (printed or displayed)	8, 18, Appendix E	429-431, 993-994, 1001-1002, E17-E20
■ Paper jam	8, 18	429-431, 993-994
■ Print quality	8, 18	429-431, 993-994
■ Safety precautions	18, 19	998-999, 1030
■ Preventive maintenance	19	1029
6.1 Identify basic networking concepts, including how a network works and the ramifications of repairs on the network. <i>Content may include the following:</i>		
■ Installing and configuring network cards	17	927-932
■ Network access	17, 18	920-922, 926-927, 988
■ Full-duplex, half-duplex	16	843
■ Cabling—Twisted Pair, Coaxial, Fiber Optic, RS-232	17	904-906
■ Ways to network a PC	17, 18	920-921, 926-927, 988
■ Physical Network topographies	17	902
■ Increasing bandwidth	16, 17	881-885, 905, 911
■ Loss of data	17	973-975
■ Network slowdown	17	973-975
■ Infrared	9, 18	459, 988
■ Hardware protocols	17	900-912

## *A+ OS Objectives*

OBJECTIVES	CHAPTERS	PAGE NUMBERS
1.1 Identify the operating system's functions, structure, and major system files to navigate the operating system and how to get to needed technical information. <i>Content may include the following:</i>		
■ Major Operating System Functions	12, 13, 14	600-602, 681-684, 743
■ Create folders	6	314-315
■ Checking OS version	12	608
■ Major Operating System components	2, 12, 13, 14	73, 600-601, 667-668, 680-684, 743
■ Explorer	5, 6	253-255, 314-316
■ My Computer	1, 3, 6, 12	50, 175, 314, 608
■ Control Panel	2, 12, 13, 14	82, 609, 669, 701, 720, 736
■ Contrasts between Windows 9x and Windows 2000	4, 14	215-216, 737-742
■ Major system files: what they are, where they are located, how they are used, and what they contain:		
<b>System, Configuration, and User Interface files</b>		
■ IO.SYS	2, 12	77-79, 608
■ BOOT.INI	13	705
■ WIN.COM	12	611-612, 614
■ MSDOS.SYS	2, 12	77-79, 606
■ AUTOEXEC.BAT	12	606, 645-646
■ CONFIG.SYS	2, 12	77-79, 608, 647-648
■ COMMAND LINE PROMPT	12, 13	614, 637, 647, 670
<b>Memory management</b>		
■ Conventional	4	193-194
■ Extended/upper memory	2, 4, 12	87, 195-196, 603
■ High memory	4	196-197, 205
■ Virtual memory	4, 12	197, 214-215, 604-606
■ HIMEM.SYS	4	199-200
■ EMM386.exe	4	201-202
<b>Windows 9x</b>		
■ IO.SYS	12	609
■ WIN.INI	12	609, 611
■ USER.DAT	12	635
■ SYSEDIT	12	608

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OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ SYSTEM.INI	12	609, 611
■ SETVER.EXE	12	612
■ SMARTDRV.EXE	6, 12	328, 648
■ MSCONFIG (98)	12	652-653
■ COMMAND.COM	12	611
■ DOSSTART.BAT	12	648
■ REGEDIT.EXE	12	639
■ SYSTEM.DAT	12	635
■ RUN COMMAND	1	50
■ DriveSpace	12	612, 620, 624
<b>Windows 2000</b>		
■ Computer Management	14	
■ BOOT.INI	13, 14	
■ REGEDIT32	13	
■ REGEDIT	13	
■ RUN CMD	14	
■ NTLDR	13, 14	703-705, 754-755
■ NTDETECT.COM	13, 14	704-705, 754-755
■ NTBOOTDD.SYS	13	705
<b>Command Prompt Procedures (Command syntax)</b>		
DIR, ATTRIB, VER, MEM, SCANDISK, DEFRAG, EDIT, XCOPY, COPY, FORMAT, FDISK, MSCDEX, SETVER, SCANREG	2, 4, 5, 6, 7, 10	75-76, 201, 205-206 250, 252-253, 256, 262, 312, 317, 319, 352, 526-527, 637
1.2 Identify basic concepts and procedures for creating, viewing, and managing files, directories, and disks. This includes procedures for changing file attributes and the ramifications of those changes (for example, security issues). <i>Content may include the following:</i>		
■ File attributes – Read Only, Hidden, System, and Archive attributes	5, 6	248-249, 316
■ File naming conventions (Most common extensions)	1, 5	40, 248-249
■ Windows 2000 COMPRESS, ENCRYPT	14	745, 764
■ IDE/SCSI	7	355-359
■ Internal/External	18, 19	1014, 1047, 1049
■ Backup/Restore	19	1050-1054

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OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ Partitioning/Formatting/File system (FAT, FAT16, FAT32, NTFS4, NTFS5, HPFS)	5, 6, 7, 13, 14	242-243, 281-282, 293, 298, 353-354, 672-673, 748-749
■ Windows-based utilities		
■ ScanDisk	6, 7	319-320, 386
■ Device Manager	12	633
■ System Manager	12	649-650
■ Computer Manager	14	766
■ MSCONFIG.EXE	12	652-653
■ REGEDIT.EXE (View information/Backup registry)	12, 13, 14	639, 718-719, 743, 762
■ REGEDIT32.EXE	13, 14	718-719, 743
■ ATTRIB.EXE	6	312
■ EXTRACT.EXE	5	257-258
■ DEFRAG.EXE	6, 7	317-318, 391
■ EDIT.COM	4	200
■ FDISK.EXE	7	352
■ SYSEDIT.EXE	12	608
■ SCANREG	12	636-638
■ WSCRIPT.EXE	19	1050
■ HWINFO.EXE	12	650
■ ASD.EXE (Automatic Skip Driver)	12	649-650
■ Cvt1.EXE (Drive Converter FAT16 to FAT 32)	12	620
2.1 Identify the procedures for installing Windows 9x, and Windows 2000 for bringing the software to a basic operational level. <i>Content may include the following:</i>		
■ Start Up	2, 12, 14, 15	71, 619-622, 748, 828-829
■ Partition	7, 13, 14, 15	352, 675, 750, 828-829
■ Format drive	7, 14, 15	354, 750, 828-829
■ Loading drivers	12, 14, 15, Appendix E	626, 629-632, 750, 828-829, E25-E29
■ Run appropriate set up utility	12, 14, Appendix E	620-622, 751, E5, E27
2.2 Identify steps to perform an operating system upgrade. <i>Content may include the following:</i>		
■ Upgrading Windows 95 to Windows 98	12	620-621

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OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ Upgrading from Windows NT Workstation 4.0 to Windows 2000	14	744-745, 749-753
■ Replacing Windows 9x with Windows 2000	13, 14	671-672, 748-752
■ Dual boot Windows 9x/Windows NT 4.0/2000	13, 14	699-700, 748-749
2.3 Identify the basic system boot sequences and boot methods, including the steps to create an emergency boot disk with utilities installed for Windows 9x, Windows NT, and Windows 2000 <i>Content may include the following:</i>		
■ Startup disk	2, 5, 14	101, 255-258, 749, 762-763
■ Safe Mode	12, 14	614, 756
■ MS-DOS mode	1, 12	41, 614-615, 647
■ NTLDR (NT Loader), BOOT.INI	13, 14	704-705, 755
■ Files required to boot	12, 13	609-613, 703-705
■ Creating emergency repair disk (ERD)	5, 14	255, 761-762
2.4 Identify procedures for loading/adding and configuring device drivers, and the necessary software for certain devices. <i>Content may include the following:</i>		
■ Windows 9x Plug and Play and Windows 2000	9, 12, 14, 15	451-454, 627, 629-632, 738, 743-744, 746, 828-829
■ Identify the procedures for installing and launching typical Windows and non-Windows applications. (Note: there is no content related to Windows 3.1)	1, 8, 12, 14	44, 46-50, 418-421, 603-604, 643-645, 769-770
■ Procedures for set up and configuring Windows printing subsystem.		
■ Setting Default printer	18	1004
■ Installing/Spool setting	18	1003
■ Network printing (with help of LAN admin)	18	1002-1004
3.1 Recognize and interpret the meaning of common error codes and startup messages from the boot sequence, and identify steps to correct the problems. <i>Content may include the following:</i>		
■ Safe Mode	12, 14	613-614, 755-756
■ No operating system found	5, 7, Appendix A	245, 380, 384, A3
■ Error in CONFIG.SYS line XX	4, Appendix A	217-218, A3
■ Bad or missing COMMAND.COM	5, 7, Appendix A, E	245, 384, A2, E10
■ HIMEM.SYS not loaded	4, Appendix A	205-206, A3

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■ Missing or corrupt HIMEM.SYS	4, Appendix A	205-206, A3
■ SCSI	7	355-359, 390
■ Swap file	4	214-215
■ NT boot issues	13, 14, Appendix E	706-710, 755-763, E24, E29
■ Dr. Watson	12	644
■ Failure to start GUI	7	377
■ Windows Protection Error	12	603-604, 644
■ Event Viewer – Event log is full	13	725
■ A device referenced in SYSTEM.INI, WIN.INI, Registry is not found	12	614, 633-635
3.2 Recognize common problems and determine how to resolve them. <i>Content may include the following:</i>		
■ Eliciting problem symptoms from customers	8, 20	410-411, 1073
■ Have customer reproduce error as part of the diagnostic process	8, 20	410-411, 1073
■ Identifying recent changes to the computer environment from the user	8, 20	413-414, 1073
■ Troubleshooting Windows-specific printing problems		
■ Print spool is stalled	18	999-1004
■ Incorrect/incompatible driver for print	18	999-1004
■ Incorrect parameter	18	1003-1004
<i>Other Common problems</i>		
■ General Protection Faults	12	603-604, 644-645
■ Illegal operation	12	603-604
■ Invalid working directory	7, Appendix A	378, A2
■ System lock up	4, 7, 12, 14	217-218, 389-390, 605-606, 757
■ Option (Sound card, modem, input device) will not function	9, 12, Appendix A, E	471-473, 632-634, A3, E21
■ Application will not start or load	4, 12, Appendix A, E	203-204, 604-605, 647, A1, E5-E6, E28
■ Cannot log on to network (option – NIC not functioning)	17	973-975
■ TSR (Terminate Stay Resident) programs and virus	4, 19, Appendix E	203-205, 1037-1040, E5, E6
■ Applications don't install	12, Appendix E	643-647, E22-E23, E27-E28
■ Network connection	17	929-930, 933-937

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OBJECTIVES	CHAPTERS	PAGE NUMBERS
■ Viruses and virus type		
■ What they are	19	1032-1035
■ Sources (floppy, emails, etc.)	19	1036-1039
■ How to determine presence	8, 19	406-407, 1040
4.1 Identify the networking capabilities of Windows including procedures for connecting to the network. <i>Content may include the following:</i>		
■ Protocols	17	917
■ IPCONFIG.EXE	17	974-975
■ WINIPCFG.EXE	17	974-975
■ Sharing disk drives	17	930-931, 967
■ Sharing print and file services	13, 18	700-701, 1005-7
■ Network type and network card	17	912-915
■ Installing and Configuring browsers	17	958, 960-961
■ Configure OS for network connection	13, 17	687-690, 955-959
4.2 Identify concepts and capabilities relating to the Internet and basic procedures for setting up a system for Internet access <i>Content may include the following:</i>		
■ Concepts and terminology	17	937-951
■ ISP	17	955, 959
■ TCP/IP	17	951, 959
■ IPX/SPX	17	899-900
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# Introduction

*Enhanced A+ Guide to Managing and Maintaining Your PC, Comprehensive Enhanced Third Edition*, was written to be the very best tool on the market today to prepare you to support personal computers. This book takes you from the just-a-user level to the I-can-fix-this level for the most common PC hardware and software concerns. This book achieves its goals with an unusually effective combination of tools that powerfully reinforce both concepts and hands-on real-world experience. It also provides thorough preparation for CompTIA's newly revised A+ Certification Exams.

This book includes:

- ◆ The powerful troubleshooting utilities software package, Nuts & Bolts 98®, on an accompanying CD, with coverage of this software integrated throughout the book
- ◆ CoursePrep® A+ Test Preparation software contains 100 test prep questions like the ones found on the A+ certification exams.
- ◆ An A+ Table of Contents provides quick reference to all of the A+ exam content.
- ◆ Comprehensive review and practice end-of-chapter material, including an itemized summary, review questions, projects, and key-term definitions
- ◆ Step-by-step instruction guides on installation, maintenance, and optimizing system performance, which are presented throughout each chapter
- ◆ A wide array of photos and screen shots supporting the text, displaying in detail the exact hardware and software features you will need to understand to manage and maintain your PC
- ◆ A unique standalone troubleshooting guide (Appendix E), indexed for both hardware and software, which distills all troubleshooting information from the book and packages for one-stop troubleshooting guidance
- ◆ Several in-depth, hands-on projects at the end of each chapter designed to make certain that you not only understand the material, but can execute procedures and make decisions on your own

In addition, the carefully structured, clearly written text is accompanied by graphics that provide the visual input essential to learning. Also, for instructors using the book in a classroom, a special CD-ROM is available that includes an Instructor's Manual, an Online Testing system, and a PowerPoint presentation.

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Coverage is balanced—while focusing on new hardware, it also covers the real work of PC repair, where some older technology remains in widespread use and still needs support. For example, the book covers the various Pentium processors, but also addresses the capabilities and maintenance of 486 processors because many are still in use. Also included is thorough coverage of operating system and applications support. While Windows 9x is the primary OS of choice for many PCs, DOS is given comprehensive coverage because it is the foundation operating system for Windows 9x and is still used in troubleshooting situations when Windows 9x or other high-overhead operating systems are not appropriate. In addition, two chapters are dedicated to Windows NT and Windows 2000, which have many powerful capabilities that make them important options, especially in the business environment.

## COMPTIA CERTIFICATION

This book provides thorough preparation for CompTIA's newly revised A+ Certification examinations. This book maps completely to all of the certification exam objectives. This certification credential's popularity among employers is growing exponentially, and obtaining certification increases your ability to gain employment and improve your salary options.



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To ensure a successful learning experience, this book includes the following pedagogical features:

- ◆ **Learning Objectives:** Every chapter opens with a list of learning objectives that sets the stage for you to absorb the lessons of the text.
- ◆ **Comprehensive Step-by-Step Troubleshooting Guidance:** Troubleshooting guidelines are included in almost every chapter. In addition, Appendix E is a unique compilation of troubleshooting information taken directly from the book, and indexed for both hardware and software. It provides a one-stop source for solving all PC problems.
- ◆ **Step-by-Step Procedures:** The book is chock-full of step-by-step procedures covering subjects from hardware installation and maintenance to optimizing system performance.
- ◆ **Art Program:** Numerous detailed photographs, three-dimensional art, and screenshots support the text, displaying hardware and software features exactly as you will see them in your work



**Tips:** Tip icons highlight additional helpful information related to the subject being discussed.

A+<sup>OS</sup>  
4.1

**A+ Icons:** All of the content that relates to CompTIA's A+ Certification exams, whether it's a page or a sentence, is highlighted with an A+ icon. The icon notes the exam name and the objective number. This unique feature highlights the relevant content at a glance, so you can pay extra attention to the material.

- ◆ **A+ Table of Contents:** This table of contents indicates every page that relates to the each certification objective. This is a valuable tool for quick reference.



**Caution Icon:** This icon highlights critical safety information. Follow these instructions carefully for your own safety.

- ◆ **End-of-Chapter Material:** Each chapter closes with the following features, which reinforce the material covered in the chapter and provide real-world, hands-on testing of the chapter's skill set:
  - ◆ **Summary:** This bulleted list of concise statements summarizes all major points of the chapter.
  - ◆ **Review Questions:** You can test your understanding of each chapter with a comprehensive set of review questions.

- ◆ **Key-Term List:** The content of each chapter is further reinforced by an end-of-chapter key-term list with definitions that are combined at the end of the book in a full-length glossary.



**Hands-On Projects:** You get to test your real-world understanding with hands-on projects involving a full range of software and hardware problems. Chapters include exercises using Nuts & Bolts software as well. Each hands-on activity in this book is preceded by the Hands-On icon and a description of the exercise that follows.

- ◆ **Behind the Scenes with Debug:** For more detailed study of the subject at hand, Appendix F, using DOS DEBUG, makes for an exciting elective study.
- ◆ **Nuts & Bolts 98® Utility Software:** The CD-ROM accompanying the book contains a limited version of Nuts & Bolts 98®, an award-winning diagnostic utility, receiving top ratings from PC Advisor, Windows Sources, Home Office Computing, PC Computing, and Boot Magazine. Many end-of-chapter projects direct you to use this software, which is designed to facilitate all aspects of installation, maintenance, diagnosis, repair, and optimization of system performance. The software comes with a 120-day license and with the ability to purchase online as well.
- ◆ **CoursePrep® A+ Test Preparation software:** 100 test preparation questions mimic the testing environment so you can practice for exam day.
- ◆ **Web site:** For updates to this book and information about our complete line of A+ PC Repair topics, please visit our Web site at [www.course.com/pcrepair](http://www.course.com/pcrepair)

## SUPPLEMENTS

For instructors using this book in a classroom environment, the following teaching materials are available on a single CD-ROM:

**Electronic Instructor's Manual:** The Instructor's Manual that accompanies this textbook includes a list of objectives for each chapter, a detailed chapter lecture notes, suggestions for classroom activities, discussion topics; additional projects and solutions.

**Course Test Manager 1.2:** Accompanying this book is a powerful assessment tool known as the Course Test Manager. Designed by Course Technology, this cutting-edge, Windows-based testing software helps instructors design and administer tests and pretests. In addition to being able to generate tests that can be printed and administered, this full-featured program also has an online testing component that allows students to take tests at the computer and have their exams automatically graded. The test bank that accompanies this book contains over 100 questions per chapter.

**PowerPoint Presentations:** This book comes with Microsoft PowerPoint slides for each chapter. These are included as a teaching aid for classroom presentation, to make available to students on the network for chapter review, or to be printed for classroom distribution.

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This book is dedicated to the covenant of God with man on earth.

Jean Andrews, Ph.D.



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## READ THIS BEFORE YOU BEGIN

The following hardware, software, and other equipment are needed to do the hands-on projects at the end of chapters:

- ◆ You need a working PC that can be taken apart and reassembled. Use a 486 or higher computer.
- ◆ Troubleshooting skills can better be practiced with an assortment of non-working expansion cards that can be used to simulate problems.
- ◆ DOS and Microsoft Windows 9x are needed to complete projects in Chapters 1 through 12. Microsoft Windows NT Workstation 4.0 is needed for Chapter 13, and Microsoft Windows Professional is needed for Chapter 14. Chapters 15 through 20 use a combination of all these operating systems and environments.
- ◆ Equipment required to work on hardware includes a grounding mat and grounding strap and flat-head and Phillips-head screwdrivers. A multimeter is needed for Chapter 11 projects.
- ◆ Before undertaking any of the lab exercises, starting with Chapter 3, please review the safety guidelines below.



**Caution Icon:** This icon highlights critical safety information. Follow these instructions carefully for your own safety.

## Installing Nuts & Bolts

Install Nuts & Bolts from the CD-ROM under either Windows 3.x or Windows 9x.

## Protect Yourself, your Hardware, and your Software

When you work on a computer it is possible to harm both the computer and yourself. The most common accident that happens when attempting to fix a computer problem is the erasing of software or data. Experimenting without knowing what you are doing can cause damage. To prevent these sorts of accidents, as well as the physically dangerous ones, take a few safety precautions. The text below describes the potential sources of damage to computers and how to protect against them.

## Power to the Computer

To protect both yourself and the equipment when working inside a computer, turn off the power, unplug the computer, and always use a grounding bracelet. Consider the monitor and the power supply to be “black boxes.” Never remove the cover or put your hands inside this equipment unless you know about the hazards of charged capacitors. Both the power supply and the monitor can hold a dangerous level of electricity even after they are turned off and disconnected from a power source.

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## Static Electricity (ESD)

Electrostatic discharge (ESD), commonly known as static electricity, is an electrical charge at rest. A static charge can build up on the surface of a non-grounded conductor and on non-conductive surfaces such as clothing or plastic. When two objects with dissimilar electrical charges touch, static electricity passes between them until the dissimilar charges are made equal. To see how this works, turn off the lights in a room, scuff your feet on the carpet, and touch another person. Occasionally you'll be able to see and feel the charge in your fingers. If you can feel the charge, then you discharged at least 3,000 volts of static electricity. If you hear the discharge, then you released at least 6,000 volts. If you see the discharge, then you released at least 8,000 volts of ESD. A charge of less than 3,000 volts can damage most electronic components. You can touch a chip on an expansion card or system board and damage the chip with ESD and never feel, hear, or see the discharge.

There are two types of damage that ESD can cause in an electronic component: catastrophic failures and upset failures. A catastrophic failure destroys the component beyond use. An upset failure damages the component so that it does not perform well, even though it may still function to some degree. Upset failures are the most difficult to detect because they are not so easily observed.

## Protect Against ESD

To protect the computer against ESD, always ground yourself before touching electronic components, including the hard drive, system board, expansion cards, processors, and memory modules. Ground yourself and the computer parts, using one or more of the following static control devices or methods:

- ◆ **Ground bracelet or static strap:** A ground bracelet is a strap you wear around your wrist. The other end is attached to a grounded conductor such as the computer case or a ground mat, or it can plug into a wall outlet (only the ground prong makes a connection!) The bracelet also contains a current-limiting device called a resistor that prevents electricity from harming you.
- ◆ **Ground mats:** Ground mats can come equipped with a cord to plug into a wall outlet to provide a grounded surface on which to work. Remember, if you lift the component off the mat, it is no longer grounded and is susceptible to ESD.
- ◆ **Static shielding bags:** New components come shipped in static shielding bags. Save the bags to store other devices that are not currently installed in a PC.

The best solution to protect against ESD is to use a ground bracelet together with a ground mat. Consider a ground bracelet to be essential equipment when working on a computer. However, if you find yourself in a situation where you must work without one, touch the computer case before you touch a component. When passing a chip to another person,

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ground yourself. Leave components inside their protective bags until ready to use. Work on hard floors, not carpet, or use antistatic spray on the carpets. Generally, don't work on a computer if you or the computer have just come inside from the cold.

Besides using a grounding mat, you can also create a ground for the computer case by leaving the power cord to the case plugged into the wall outlet. This is safe enough because the power is turned off when you work inside the case. However, if you happen to touch an exposed area of the power switch inside the case, it is possible to get a shock. Because of this risk, in this book, you are directed to unplug the power cord to the PC before you work inside the case.

There is an exception to the ground-yourself rule. Inside a monitor case, there is substantial danger posed by the electricity stored in capacitors. When working inside a monitor, you *don't* want to be grounded, as you would provide a conduit for the voltage to discharge through your body. In this situation, be careful *not* to ground yourself.

When handling system boards and expansion cards, don't touch the chips on the boards. Don't stack boards on top of each other, which could accidentally dislodge a chip. Hold cards by the edges, but don't touch the edge connections on the card.

Don't touch a chip with a magnetized screwdriver. When using a multimeter to measure electricity, be careful not to touch a chip with the probes. When changing DIP switches, don't use a graphite pencil, because graphite conducts electricity; a very small screwdriver works very well.

After you unpack a new device or software that has been wrapped in cellophane, remove the cellophane from the work area quickly. Don't allow anyone who is not properly grounded to touch components. Do not store expansion cards within one foot of a monitor, because the monitor can discharge as much as 29,000 volts of ESD onto the screen.

Hold an expansion card by the edges. Don't touch any of the soldered components on a card. If you need to put an electronic device down, place it on a grounded mat or on a static shielding bag. Keep components away from your hair and clothing.

## Protect Hard Drives and Disks

Always turn off a computer before moving it, to protect the hard drive, which is always spinning when the computer is turned on (unless the drive has a sleep mode). Never jar a computer while the hard disk is running. Avoid placing a PC on the floor, where the user can accidentally kick it.

Follow the usual precautions to protect disks. Keep them away from magnetic fields, heat, and extreme cold. Don't open the floppy shuttle window or touch the surface of the disk inside the housing. Treat disks with care and they'll generally last for years.

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